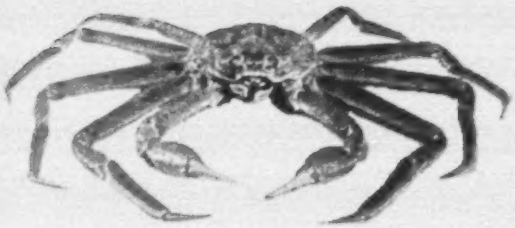
Fisheries and Oceans Canada | Pêches et Océans Canada
Ecosystems and Oceans Science | Sciences des écosystèmes et des océans
Quebec Region
Canadian Science Advisory Secretariat
Science Advisory Report 2015/033

ASSESSMENT OF THE ESTUARY AND NORTHERN GULF OF ST. LAWRENCE (AREAS 13 TO 17, 12A, 12B, 12C AND 16A) SNOW CRAB STOCKS IN 2014



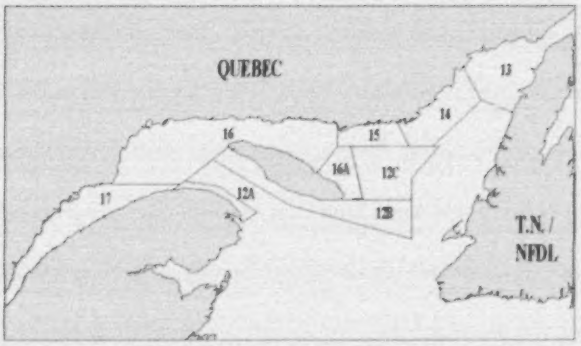


Figure 1. Snow Crab management areas in the Estuary and the northern Gulf of St. Lawrence.

Context:

The Snow Crab fishery in the Estuary and the northern Gulf of St. Lawrence began in the late 1960s. The fishery experienced a boom from 1979 to 1985 and a management approach based on the TAC (total allowable catch) was gradually introduced between 1985 and 1995. There are nine management areas (13 to 17, 16A, 12A, 12B and 12C) (Figure 1).

Landings have varied depending on the adjusted TACs based on recruitment waves and troughs that affect the quantity of crabs available to the fishery (Figure 2), with maximum levels recorded in 1995 (7,879 t) and 2002 (10,372 t). Landings dropped considerably in 2003 owing to the lower TACs established in response to signs of overfishing, mainly in Area 16. Landings totalled 9 919 t in 2014.

The fishery targets only males with a carapace width ≥ 95 mm. White crab (crab that has recently moulted) and adolescent males may be returned to the water during the fishing season to enhance their meat yield and give them a chance to reproduce. Furthermore, since 1985, when the proportion of white crab in catches at sea exceeds 20%, the fishery in the area concerned is automatically closed to minimize the mortality of these very fragile crabs, which will be available to the fishery the following year.

The DFO Fisheries and Aquaculture Management Branch, Quebec Region, requested a resource status assessment as well as a science advisory report, in order to set the 2015 quotas. A scientific peer review was conducted on February 24 and 25, 2015. Participants included representatives from DFO Science and Fisheries and Aquaculture Management, the fishing industry and First Nations.

SUMMARY

- Stocks in the Middle and Lower North Shore of the Gulf of St. Lawrence (Areas 13, 14, 15, 16, 16A and 12C) had high commercial biomass despite a decrease in Areas 16 and 12C. Fishery recruitment throughout these areas is still high, but may decrease starting in 2016 or 2017. Conversely, the commercial biomass remains low in Area 17, but recruitment has started to recover. The commercial biomass in Areas 12A and 12B has diminished and recruitment during the next few years could depend on production in adjacent areas.
- The purpose of conservation is to maintain an adequate male reproductive biomass in order to ensure the recovery or maintenance of the population in a given area. Recommendations assume that the natural mortality rate will be the same in 2015 as in previous years.

Perspectives

Area 17

- The drop in the combined index suggests that 2015 catches should decrease compared to 2014:
  1. A status quo in catches would lead to a high harvesting intensity, which would slow the rate of increase of the biomass available to the fishery;
  2. A decrease of approximately 10% should lead to a moderate harvesting intensity and help the biomass available to the fishery increase more rapidly;
  3. Any decrease greater than 10% would lead to an even more rapid increase in biomass available to the fishery and would reduce the risk of harvesting large quantities of white crab in 2016.
- Any additional measures for protecting white crab would benefit the stock.

Area 16

- The drop in the combined index suggests that 2015 catches should decrease compared to 2014:
  1. Too low a decrease in catches would lead to a high harvesting intensity and possibly to a rapid decrease in biomass available to the fishery starting in 2016;
  2. It is unlikely that a decrease of approximately 20% would lead to an excessively high harvesting intensity and would moderate the expected short- and medium-term decline in stocks;
  3. Any decrease greater than 20% could lead to the maintenance of a substantial biomass available to the fishery over a longer period of time.

Area 15

- The combined index suggests that it is possible to maintain 2015 catches at their 2014 levels:
  1. An increase in catches greater than 10% would lead to a high harvesting intensity and could reduce the biomass available to the fishery in 2016;
  2. A status quo would likely not entail an excessively high harvesting intensity and would moderate the effects of lower expected recruitment in the medium term;

3. Any decrease in catches could lead to maintenance of a substantial biomass available to the fishery over a longer period of time.

Areas 14 and 13

- The rise in the combined index suggests that it is possible to increase 2015 catches compared to 2014 levels:
  1. An increase in catches greater the 25% would lead to a high harvesting intensity and could reduce the biomass available to the fishery in 2016;
  2. It is unlikely that an increase of approximately 20% would lead to an excessively high harvesting intensity and would moderate the effect of lower expected recruitment in the medium term;
  3. An increase of less than 15% could lead to the maintenance of a substantial biomass available to the fishery over a longer period of time.
- For Area 13, it will be necessary to foster a better distribution of the fishing effort between the northern and southern parts of the area.

Area 12A

- The drop in the combined index suggests that 2015 catches should decrease compared to 2013 and 2014:
  1. Too low a decrease in catches could lead to a high harvesting intensity and possibly to a decrease in the biomass available to the fishery in 2016;
  2. A decrease of approximately 20% should lead to a moderate harvesting intensity and help to maintain the biomass available to the fishery;
  3. A larger decrease would foster an increase in biomass available to the fishery in the short and medium term.

Area 12B

- The drop in the combined index, despite some uncertainty, suggests that 2015 catches should decrease considerably compared to 2014:
  1. Too low a decrease in catches would lead to a high harvesting intensity and to a sharp decrease in the biomass available to the fishery in 2016;
  2. A decrease of approximately 25% could lead to a moderate harvesting intensity, which would reduce the expected short- and medium-term decline in stocks;
  3. An even larger decrease would be consistent with biomass indicators and could stabilize the biomass available to the fishery in the short and medium term.

Area 12C

- The drop in the combined index suggests that 2015 catches should decrease compared to 2014:
  1. A status quo in catches would lead to a high harvesting intensity and possibly to a decrease in the biomass available to the fishery in 2016;

2. It is unlikely that a decrease of approximately 10% would lead to an excessively high harvesting intensity and would moderate the effect of lower expected recruitment in the medium term;
3. Any decrease greater than 15% could lead to the maintenance of a substantial biomass available to the fishery over a longer period of time.

Area 16A

- The rise in the combined index suggests that it is possible to slightly increase 2015 catches compared with 2014:
  1. An increase in catches greater than 15% would lead to a high harvesting intensity and could decrease the biomass available to the fishery in 2016;
  2. It is unlikely that an increase of approximately 10% would lead to an excessively high harvesting intensity and could foster maintenance of the biomass available to the fishery;
  3. A status quo or a decrease in catches could lead to maintenance of a substantial biomass available to the fishery over a longer period of time.

INTRODUCTION

Species biology

In Canada, Snow Crab can be found from the southern tip of Nova Scotia to halfway up the Labrador coast, as well as in the Estuary and Gulf of St. Lawrence. In the Gulf of St. Lawrence, commercial-size males live at depths ranging from 60 m to 220 m, except during their winter moulting and reproductive periods, during which they migrate to shallower waters. Snow Crab stop growing after the terminal moult. Males are considered adolescents (small claws) prior to the terminal moult and adults (large claws) afterward. Male carapace width (CW) ranges from 40 mm to 165 mm after the terminal moult. If they do not undergo their terminal moult earlier, males reach legal size (95 mm CW) at about nine years of age. Snow Crab recruitment is periodic or episodic and varies considerably over an 8- to 12-year cycle. The entry of recruits into the fishery can be determined by regular monitoring of landings (carapace size and condition) and the catch rate (catch per unit effort, CPUE), and is confirmed by scientific trap and trawl surveys.

ASSESSMENT OF THE RESOURCE

Analyses of all areas are based on fishing data from logbooks, processing plant purchase slips and dockside weighing summaries, along with catch sampling data obtained from the Observers Program and DFO samplers. In 2014, the industry conducted a trap-based research survey in all fishing areas (except in Area 13 where two independent surveys were conducted) and the findings were incorporated into the stock status analyses. These surveys help determine the average NUE (numbers per unit effort) of legal-size crabs by area and the NUE of adolescent crabs with carapaces over 78 mm wide that will reach or exceed legal size during the next moult. In Area 17, the catch of adolescent crabs from the experimental traps, which have a smaller mesh (15 mm when stretched), during the post-season survey was also examined to obtain an early indication of the strength of the cohorts that would reach the legal size. The results of the trawl research surveys conducted in 2013 and 2014 in areas 17 and 13 were used to calculate a juvenile or adult crab abundance index.

The fishery's raw catches per unit effort (CPUE) were standardized using an additive model to account for seasonal changes, gear type, soak time and fishing site. The proportion of recruits (or new crabs),

which can be identified by their new carapace (carapace conditions 1 and 2), was determined by dockside samplers.

A combined index was developed to obtain a better estimate of the short-term commercial biomass trend and help increase the consistency of the inter-annual recommendations for a given stock. This index is based on the two biomass indices, that is, the post-season NUE for adult males ≥ 95 mm (the average NUE from the north and south surveys in Area 13) and the standardized commercial CPUE. The combined index is calculated by standardizing each of the indices according to their respective average and standard deviation over the 2000-2012 reference period and averaging them for the current year.

Data on the size structure of crabs sampled at sea, dockside and during trap surveys were also used.

To date, data on female insemination levels have been collected sporadically in certain areas. Annual systematic sampling of each area is recommended so this parameter can be used for stock status assessments because it is a measure of primiparous female mating success and the relative abundance of large adult males.

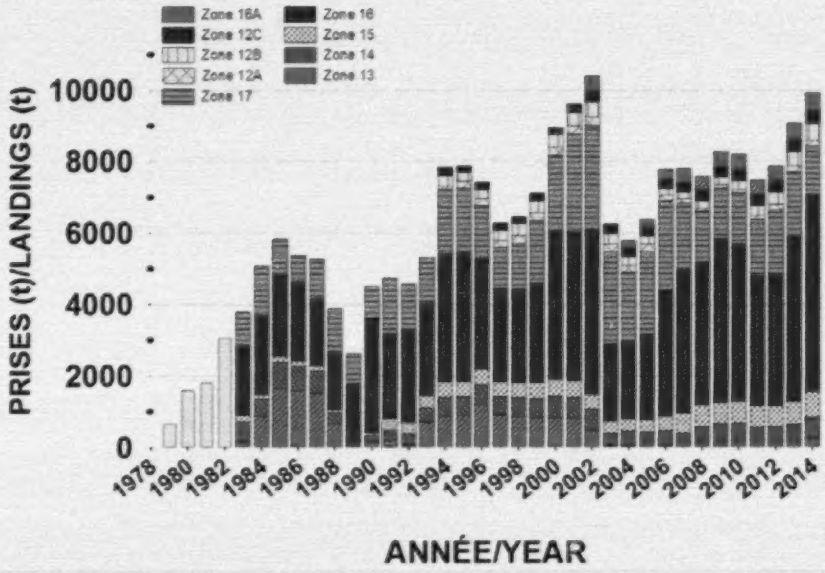


Figure 2. Snow Crab landings in the Estuary and northern Gulf of St. Lawrence. From 1979 to 1982, landings were not attributed to their area of origin.

Area 17

Description of the fishery

In Area 17, there are 21 fishers who hold regular licences in group A (88% of the TAC) and 24 fishers who hold special licences in group B (12% of the TAC). The TAC decreased by 20% between 2013 and 2014 to 1,447 t (Figure 3). The fishing season opened on April 1 and closed on June 20. Catches totaled 1 342 t.

Resource status in 2014

Commercial fishery. The standardized CPUE decreased from 2013 to 2014 and is now far below the historical average (Figure 4). Landings have been dominated by intermediate-shell crabs (condition 3) since 2010 because of a decrease in recruitment to low levels. There was a sharp decrease in the average size of legal-size crabs caught at sea from 2013 (113 mm) to 2014 (109.3 mm).

Fishery-independent surveys. The trap-based research survey, a data series that began in 1996 on the North shore and in 1999 on the South Shore, indicates that the NUE of adults ≥ 95 mm increased very slightly in 2014 (Figure 5), due to an increase in the number of recruits (Figure 6), but is nonetheless far below the average. There was a sharp increase in the NUE of adolescent crabs (Figure 6). An examination of the catch from the traps with a smaller mesh (experimental traps) and the results of the trawl survey conducted in 2013 also showed a large number of adolescent crabs, which should lead to a greater recruitment to the fishery during the next four years. Thus, given the low residual biomass, there is a high risk of observing a large number of white crab (condition 1) in the catches. The average size of legal-size adult crabs decreased during the 2014 post-season survey, suggesting that it will do likewise during the 2015 commercial catch.

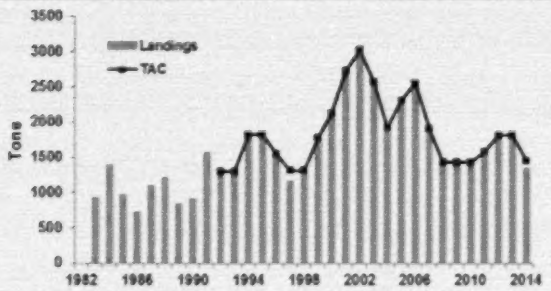


Figure 3. Landings and TAC in Area 17 from 1983 to 2014.

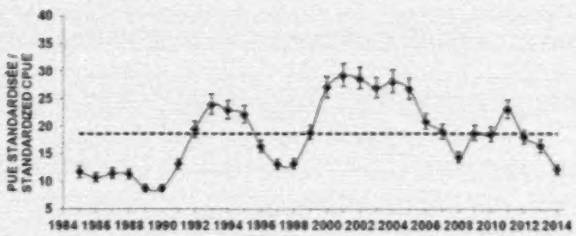


Figure 4. Standardized CPUE ± confidence interval in the commercial fishery from 1985 to 2014 in Area 17. The dotted line shows the data series average.

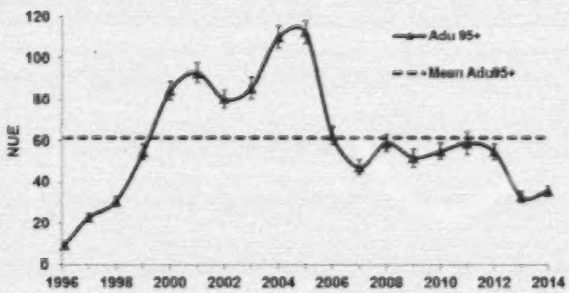


Figure 5. Catch rates (NUE), with confidence interval and average, of adult crabs ≥ 95 mm, from the post-season survey in Area 17 from 1996 to 2014.

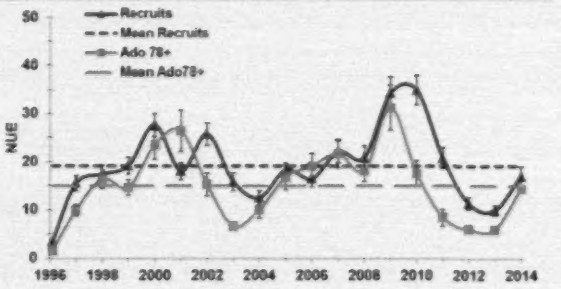


Figure 6. Catch rates (NUE), with confidence interval and average, of adolescent crabs ≥ 78 mm and recruits from the post-season survey in Area 17 from 1996 to 2014.

The combined index of commercial CPUE and of NUE from the post-season survey decreased in 2014 compared to 2013 and is low. This index suggests that there will be less biomass available to the fishery in 2015 than there was in 2014.

In 2014, the average amount of sperm stored in the females' spermathecae was low, indicating a sex ratio imbalance favouring females.

Perspectives and conclusions

The drop in the combined index suggests that 2015 catches should decrease compared to 2014:

1. A status quo in catches would lead to a high harvesting intensity, which would slow the rate of increase of the biomass available to the fishery;
2. A decrease of approximately 10% should lead to a moderate harvesting intensity and help the biomass available to the fishery increase more rapidly;
3. Any decrease greater than 10% would lead to an even more rapid increase in the biomass available to the fishery and reduce the risk of harvesting large quantities of white crab in 2016.

Any additional measures for protecting white crab would benefit the stock.

Area 16

Description of the fishery

In Area 16, there are 38 fishers who hold regular Snow Crab licences in group A (92.7% of the TAC) and 16 who hold special licences in group B (7.3% of the TAC). The TAC increased by 25% in 2013 and by 20% in 2014 to reach a peak of 5 527 t (Figure 7). The fishery opened on April 15 and closed on July 21. The TAC was reached.

Resource status in 2014

Commercial Fishery. The standardized CPUE remained stable in 2014 compared to 2013 and is now sharply above the historical average (Figure 8). Landings since 2006 have consisted primarily of recruits (carapace conditions 1 and 2), which could have been the result of high fishing pressure at the outset of the period, which was recently followed by high recruitment to the fishery.

Fishery-independent surveys. The trap-based research survey, conducted every fall since 1994, shows that the NUE of adults ≥ 95 mm (Figure 9) and of recruits (Figure 10) decreased in 2014 compared to 2013, but remained above the average. The NUE of adolescents ≥ 78 mm, which has decreased to a value close to the average (Figure 10), and the trawl survey conducted every year in Sainte-Marguerite Bay near Sept-Îles, show that the recruitment wave, which has helped the fishery for the past several years, will decrease stating in 2015-2016. The trailing edge of the recruitment wave should however contribute to maintaining a relatively high commercial biomass in 2015.

The combined index of commercial CPUE and of NUE from the post-season survey decreased in 2014 compared to 2013. While it is still high, it suggests that the biomass available to the fishery in 2015 will be considerably lower than in 2014.

The spermathecae of primiparous females from Sainte-Marguerite Bay contained more sperm in 2012-2014 than in the previous three years, indicating a relatively greater availability of large males.

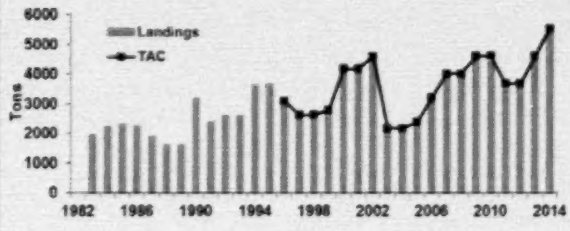


Figure 7. Landings and TAC in Area 16 from 1983 to 2014.

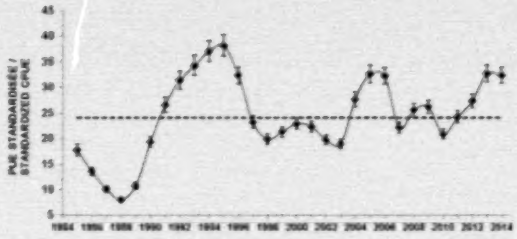


Figure 8. Standardized CPUE ± confidence interval in the commercial fishery from 1985 to 2014 in Area 16. The dotted line shows the data series average.

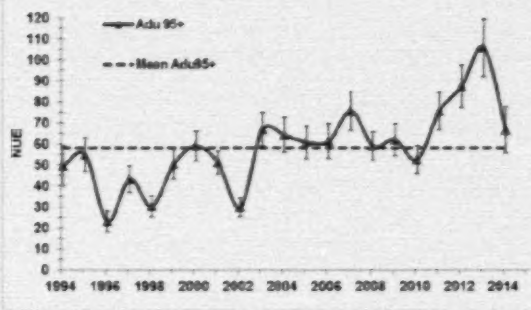


Figure 9. Catch rates (NUE), with confidence interval and average, of adult crabs ≥ 95 mm from the post-season survey in Area 16 from 1994 to 2014.

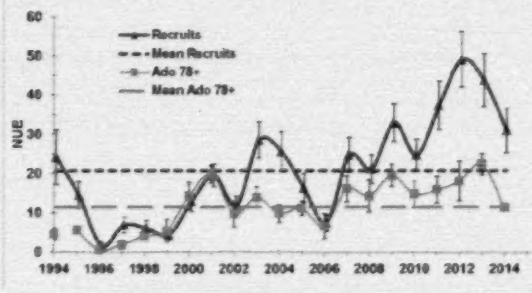


Figure 10. Catch rates (NUE), with confidence interval and average, of recruits and adolescents ≥ 78 mm from the post-season survey in Area 16 from 1994 to 2014.

Perspectives and conclusions

The drop in the combined index suggests that 2015 catches should decrease compared to 2014:

1. Too low a decrease in catches would lead to a high harvesting intensity and possibly to a rapid decrease in the biomass available to the fishery starting in 2016;
2. It is unlikely that a decrease of approximately 20% would lead to an excessively high harvesting intensity and would moderate the expected short- and medium-term decline in stocks;
3. Any decrease greater than 20% could lead to the maintenance of a substantial biomass available to the fishery over a longer period of time.

Area 15

Description of the fishery

Area 15 has eight regular licences (with 91% of the TAC) as well as temporary allocations (with 9% of the TAC). The TAC increased by 10% in 2013 and in 2014 to reach a peak of 718 t (Figure 11). The TAC was reached. In 2014, the fishery opened on April 27 and closed on August 2.

Resource status in 2014

Commercial Fishery. The standardized CPUE decreased very slightly in 2014 compared to 2013 but remains considerably above the historical average (Figure 12). Landings in 2014 were primarily intermediate-shell crabs (condition 3), while recruits (carapace conditions 1 and 2) were still plentiful.

Fishery-independent surveys. The trap-based research survey, conducted since 1998, shows an increase in the NUE of adults ≥ 95 mm to a relatively high value (Figure 13) because of heavy recruitment (Figure 14). The NUE of adolescent crabs ≥ 78 mm has been decreasing since 2011, to a value that is below average in 2014 (Figure 14), suggesting a decrease in recruitment in the medium term.

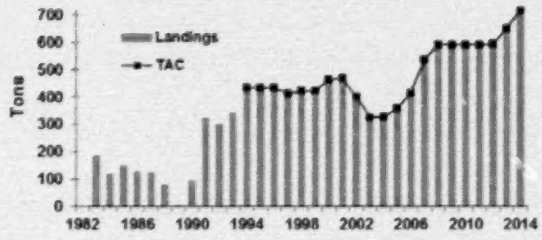


Figure 11. Landings and TAC in Area 15 from 1983 to 2014.

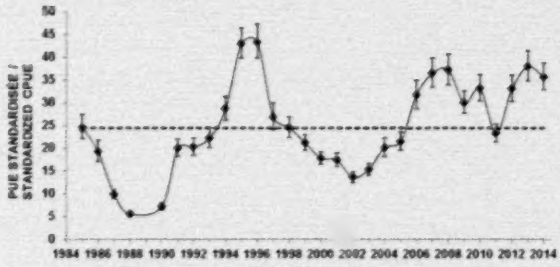


Figure 12. Standardized CPUE ± confidence interval in the commercial fishery from 1985 to 2014 in Area 15. The dotted line shows the data series average.

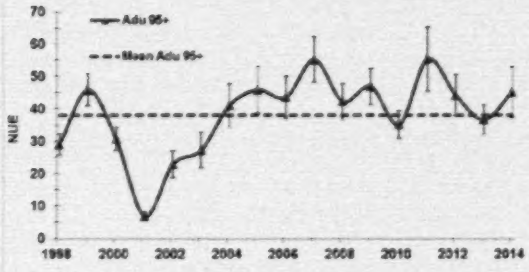


Figure 13. Catch rates (NUE), with confidence interval and average, of adult crabs ≥ 95 mm from the post-season survey in Area 15 from 1998 to 2014.

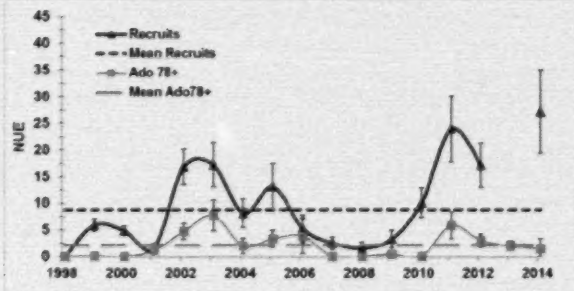


Figure 14. Catch rates (NUE), with confidence interval and average, of recruits and adolescent crabs ≥ 78 mm from the post-season survey in Area 15 from 1998 to 2014.

The combined index of commercial CPUE and of NUE in the post-season survey increased slightly between 2013 and 2014, to a relatively high value. This index suggests that there will be slightly more biomass available to the fishery in 2015 than there was in 2014.

Perspectives and conclusions

The combined indicator suggests that it is possible to maintain 2015 harvests at their 2014 levels:

1. An increase in catches greater than 10% would lead to a high harvesting intensity and could reduce the biomass available to the fishery in 2016;

2. A status quo would likely not entail an excessively high harvesting intensity and would moderate the effects of lower expected recruitment in the medium term;
3. Any decrease in catches could lead to maintenance of a substantial biomass available to the fishery over a longer period of time.

Area 14

Description of the fishery

Area 14 has 21 regular licences. The TAC increased by 10% in 2013 and by 35% in 2014, to 605 t (Figure 15). In 2014, the fishing season opened on May 22, closed on August 27 and the TAC was reached.

Resource status in 2014

Commercial fishery. The standardized CPUE increased considerably from 2013 to 2014 to a value sharply above the average (Figure 16). Recruits (carapace conditions 1 and 2), whose numbers were increasing in landings from 2008 to 2013, decreased in 2014 to reach a proportion similar to intermediate-shell crabs (condition 3).

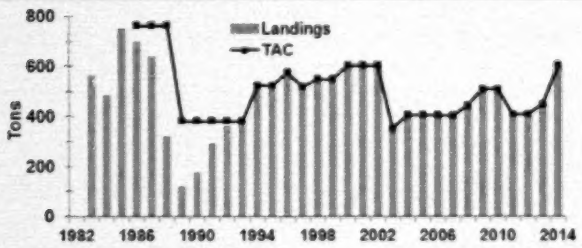


Figure 15. Landings and TAC in Area 14 from 1983 to 2014.

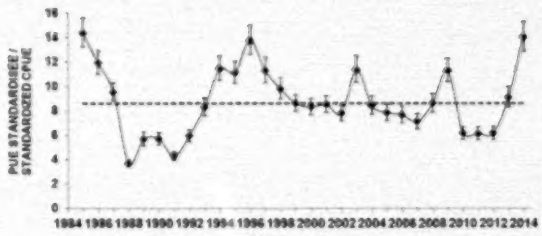


Figure 16. Standardized CPUE ± confidence interval in the commercial fishery from 1985 to 2014 in Area 14. The dotted line shows the data series average.

Fishery-independent survey. The trap-based research survey, conducted since 1996, indicates that the NUE of adults ≥ 95 mm (Figure 17) and of recruits (Figure 18) increased in 2014 compared to 2013, to values sharply above the average. The NUE for adolescents ≥ 78 mm has decreased, but remains above the average (Figure 18), which points to the maintenance of good recruitment to the fishery in the short term.

The combined index of commercial CPUE and of NUE from the post-season survey increased to its highest level. This index suggests that there will be more biomass available to the fishery in 2015 than there was in 2014.

Perspectives and conclusions

The rise in the combined index suggests that it is possible to increase 2015 catches compared to 2014:

1. An increase in catches greater than 25% would lead to a high harvesting intensity and could decrease the biomass available to the fishery in 2016;
2. It is unlikely that an increase of approximately 20% would lead to an excessively high harvesting intensity and would moderate the effect of lower expected recruitment in the medium term;

3. Any increase less than 15% could lead to the maintenance of a substantial biomass available to the fishery over a longer period of time.

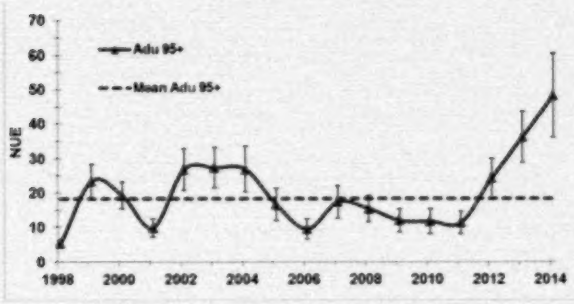


Figure 17. Catch rates (NUE), with confidence interval and average, of adult crabs ≥ 95 mm and those left by the fishery, from the post-season survey in Area 14 from 1998 to 2014.

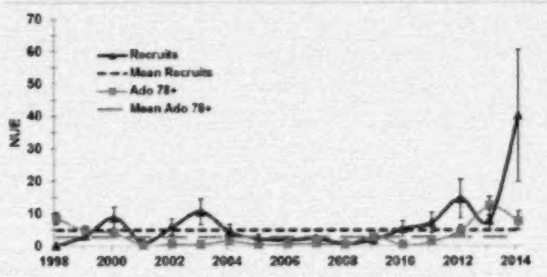


Figure 18. Catch rates (NUE), with confidence interval and average, of adolescent crabs ≥ 78 mm and recruits from the post-season survey in Area 14 from 1998 to 2014.

Area 13

Description of the fishery

Area 13 has 43 regular fishers from Quebec and 6 from Newfoundland. The area was placed under a moratorium from 2003 to 2007 as a result of a marked decline in the biomass of legal-size crab. However, an index fishery with an annual TAC of 50 t was approved in 2003, 2004 and 2006. The area was opened to the commercial fishery in 2008. The TAC was 188 t in 2013, then it increased by 25% in 2014 to 235 t (Figure 19). The fishery opened on May 12 and closed on August 10. The TAC was met.

Resource status in 2014

Commercial fishery. The standardized CPUE remained stable in 2014 compared to 2013 and is now above the historical average (Figure 20). Landings had a small majority of recruits (carapace conditions 1 and 2) that constitute a rising proportion of landings since 2010. The area harvested since 2008 was relatively small compared to the total areas traditionally harvested and, during the past few years, the fishing effort was mostly concentrated in the south. The average size of legal-size crabs caught at sea increased to a value (106.9 mm) sharply above the average (104.1 mm), but remains low compared to that in the other areas of the northern Gulf of St. Lawrence.

Fishery-independent surveys. The trap-based research surveys, conducted since 1999 on the North Shore and the South Shore have recently become substantially different. On the North Shore, the NUE of adults ≥ 95 mm (Figure 21) and that of recruits (Figure 23) increased significantly since 2012 and are sharply above the average in 2014, while they have decreased on the South Shore to values considerably below the average (Figures 22 and 24). The average of both surveys gives a commercial biomass index that is larger in 2014 than in 2013. The NUE of adolescents ≥ 78 mm is low in both sectors of the Area, suggesting a decrease in recruitment in the medium term. The trawl survey covering the northern part of Area 13 showed a sharp increase in recruits and a decrease in adolescent crabs between 62 and 95 mm in 2014, which is consistent with the post-season survey results. The survey also showed a high abundance of immature crabs, under 40 mm, which points to the beginning of a new wave of recruitment to the fishery in five to seven years.

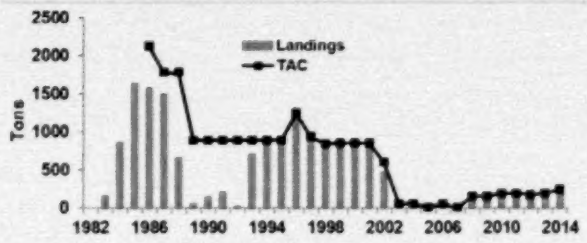


Figure 19. Landings and TAC in Area 13 from 1983 to 2014.

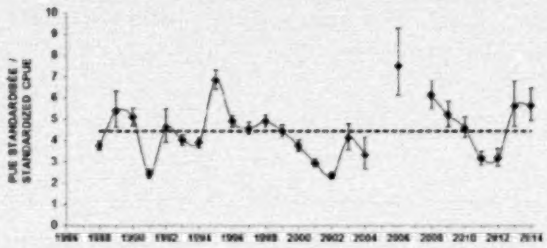


Figure 20. Standardized CPUE ± confidence interval in the commercial fishery from 1988 to 2014 in Area 13. The dotted line shows the 1988-2013 data average.

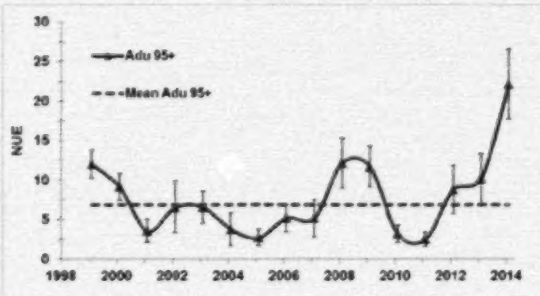


Figure 21. Catch rates (NUE), with confidence interval and average, of adult crabs ≥ 95 mm from the post-season survey in Area 13 North from 1999 to 2014.

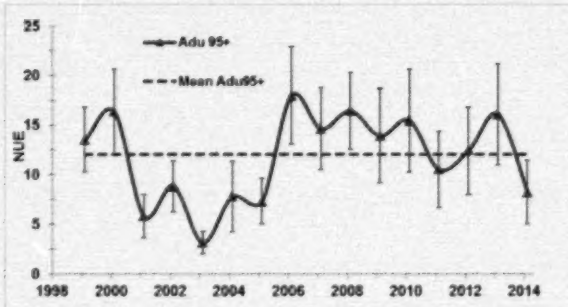


Figure 22. Catch rates (NUE), with confidence interval and average, of adult crabs ≥ 95 mm from the post-season survey in Area 13 South from 1999 to 2014.

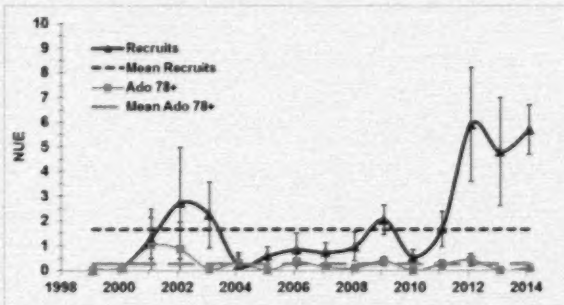


Figure 23. Catch rates (NUE), with confidence interval and average, of adolescent crabs ≥ 78 mm and recruits from the post-season survey in Area 13 North from 1999 to 2014.

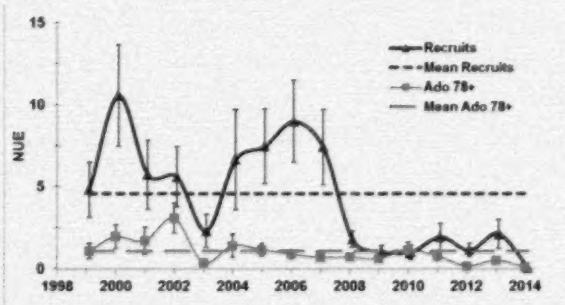


Figure 24. Catch rates (NUE), with confidence interval and average, of adolescent crabs ≥ 78 mm and recruits from the post-season survey in Area 13 South from 1999 to 2014.

The combined index of commercial CPUE and of average NUE from the post-season surveys increased for a third consecutive year. This index suggests that there will be more biomass available to the fishery in 2015 than there was in 2014.

Perspectives and conclusions

The rise in the combined index suggests that it is possible to increase 2015 catches compared to 2014:

1. An increase in catches greater than 25% would lead to a high harvesting intensity and could decrease the biomass available to the fishery in 2016;
2. It is unlikely that an increase of approximately 20% would lead to an excessively high harvesting intensity and would moderate the effect of lower expected recruitment in the medium term;
3. Any increase of less than 15% could lead to the maintenance of a substantial biomass available to the fishery over a longer period of time.

It will be necessary to foster a better distribution of the fishing effort between the northern and southern parts of the Area.

Area 12A

Description of the fishery

Area 12A has 10 regular licences. The TAC was 174 t in 2013, and was increased by 10% in 2014 to 191 t (Figure 25). In 2014, the fishing season opened on April 5 and closed on June 13. Catches totaled 178 t.

Resource status in 2014

Commercial fishery. The standardized CPUE decreased from its highest value in 2013 to a value equal to the series average in 2014 (Figure 26). There were very few recruits (carapace conditions 1 and 2) in the landings that were heavily dominated by intermediate-shell crabs (condition 3).

Fishery-independent survey. The trap-based research survey, which started in 2000, was not conducted in 2013. The NUE of adults ≥ 95 mm decreased in 2014 compared to 2012, to a value sharply below the average (Figure 27). The NUE of recruits decreased in 2014 compared to 2012. Its value is the lowest in the series (Figure 28). The NUE of adolescents ≥ 78 mm increased in 2014 and is above the average (Figure 28), pointing to a higher recruitment to the fishery in the medium term.

The combined index of commercial CPUE and of average NUE from the post-season survey decreased compared to 2012 and is below the average. The biomass available to the fishery will thus be lower in 2015 than it was in 2013.

It is important to note that the abundance of crabs in Area 12A is partially determined by overflow from adjacent areas (17 to the west and 12 to the east).

Perspectives and conclusions

The drop in the combined index suggests that 2015 catches should decrease compared to 2013 and 2014:

1. Too low a decrease in harvest levels could lead to a high harvesting intensity and to a decrease in the biomass available to the fishery in 2016;
2. A decrease of approximately 20% should lead to a moderate harvesting intensity and help maintain the biomass available to the fishery;
3. A greater decrease would foster an increase in the biomass available to the fishery in the short and medium term.

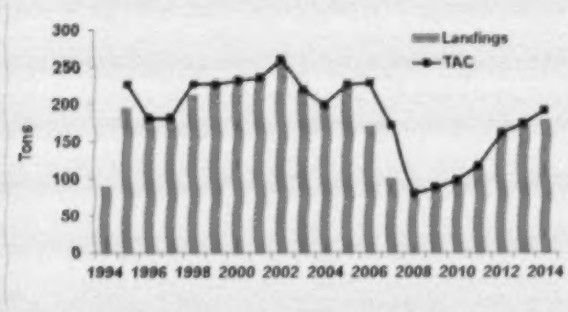


Figure 25. Landings and TAC in Area 12A from 1994 to 2014.

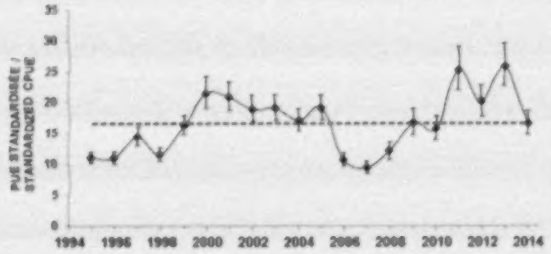


Figure 26. Standardized CPUE ± confidence interval in the commercial fishery from 1995 to 2014 in Area 12A. The dotted line shows the data series average.

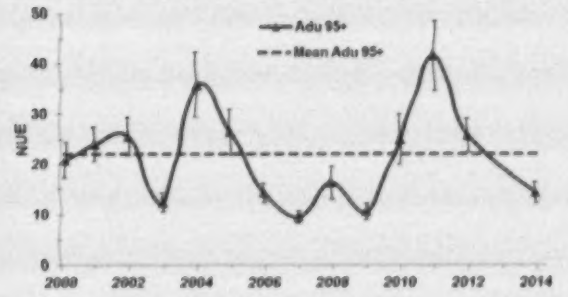


Figure 27. Catch rates (NUE), with confidence interval and average, of adult crabs ≥ 95 mm from the post-season survey in Area 12A from 2000 to 2014.

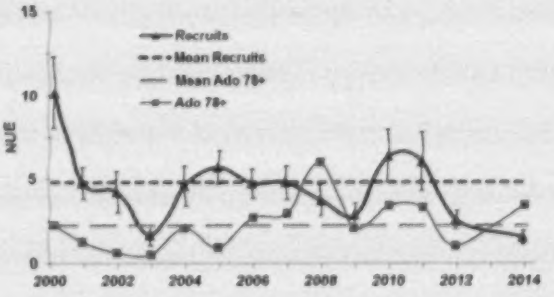


Figure 28. Catch rates (NUE), with confidence interval and average, of adolescent crabs ≥ 78 mm and recruits from the post-season survey in Area 12A from 2000 to 2014.

Area 12B

Description of the fishery

Area 12B has 8 regular licences. The TAC gradually increased from 246 t in 2010 to 468 t in 2014 (Figure 29). The fishing season opened on April 4 and closed on June 30. Catches totalled 458 t.

Resource status in 2014

Commercial fishery. The standardized CPUE decreased sharply in 2014 compared to 2013, to a value slightly below the historical series average (Figure 30). This decrease in catches is inconsistent with the 2013 combined index, which suggests that the biomass available to the fishery will be high in 2014. The 2014 fishing season was atypical in comparison with the previous years, in the sense that the CPUE was very low at the start, possibly due to environmental conditions. Landings contained a majority of intermediate-shell crabs (condition 3) each year beginning in 2005, and, in 2014, the proportion of recruits (carapace conditions 1 and 2) was lower than that of old crabs (carapace conditions 4 and 5).

Fishery-independent survey. The trap-based research survey, conducted since 2001 (except in 2005), shows that the NUE of adults ≥ 95 mm (Figure 31) and of recruits (Figure 32) decreased sharply in 2014 compared to 2013 to below average.

The NUE of adolescents ≥ 78 mm decreased and is below the average, pointing to lower recruitment in the short and medium term (Figure 32).

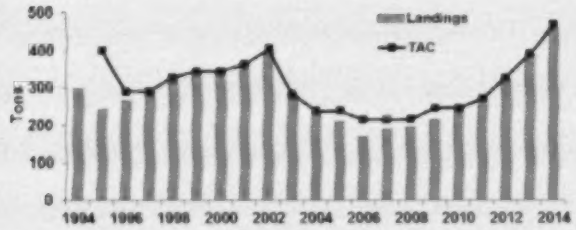


Figure 29. Landings and TAC in Area 12B from 1994 to 2014.

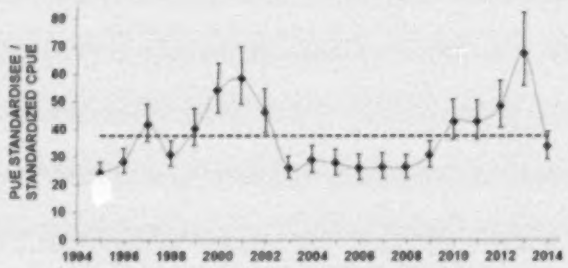


Figure 30. Standardized CPUE ± confidence interval in the commercial fishery from 1995 to 2014 in Area 12B. The dotted line shows the data series average.

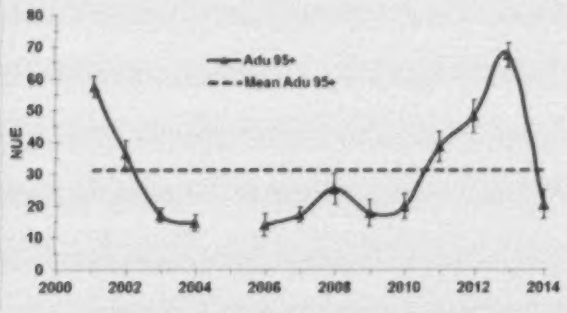


Figure 31. Catch rates (NUE), with confidence interval and average, of adult crabs ≥ 95 mm from the post-season survey in Area 12B from 2001 to 2014 (except for 2005).

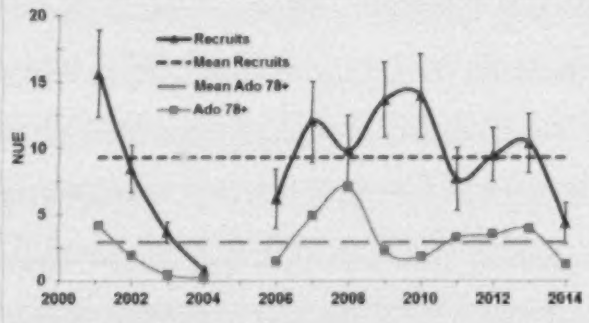


Figure 32. Catch rates (NUE), with confidence interval and average, of adolescent crabs ≥ 78 mm and recruits from the post-season survey in Area 12B from 2001 to 2014 (except for 2005).

The combined index of commercial CPUE and of NUE from the post-season survey decreased sharply in 2014. This index suggests that there will be less biomass available to the fishery in 2015 than there was in 2014.

Perspectives and conclusions

The drop in the combined index, despite some uncertainty, suggests that 2015 catches should decrease considerably compared to 2014:

1. Too low a decrease in catches could lead to a high harvesting intensity and cause a sharp decrease in the biomass available to the fishery in 2016;
2. A decrease of approximately 25% could lead to a moderate harvesting intensity, which would reduce the expected short- and mid-term decline in stocks;
3. An even greater decrease would be consistent with biomass indicators and could stabilize the biomass available to the fishery in the short and medium term.

Area 12C

Description of the fishery

Area 12C includes two banks (north and south sectors) separated by the deep channel of the Jacques-Cartier Strait. Area 12C has 5 regular licences (68.7% of the TAC) as well as temporary allocations (31.3% of the TAC). The TAC increased by 10% in 2013 and remained stable in 2014, to a peak of 352 t (Figure 33). The fishery opened on April 28 and closed on August 3. The TAC was reached.

Resource status in 2014

Commercial fishery. The standardized CPUE increased slightly in 2014 compared to 2013, to a value close to the average (Figure 34). The fishing effort was concentrated mainly in the northern part of the Area. The number of recruits (carapace conditions 1 and 2), which was rising in catches since 2011, decreased and the majority of crab landings in 2014 consisted of intermediate-shell crabs (condition 3).

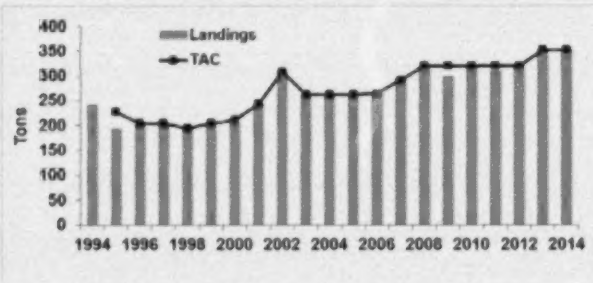


Figure 33 Landings and TAC in Area 12C from 1994 to 2014.

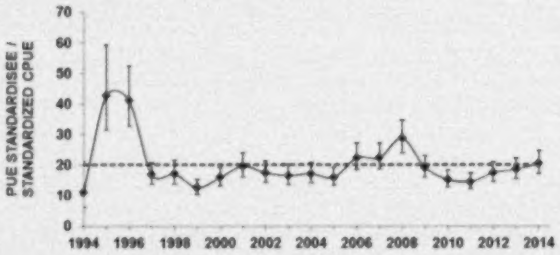


Figure 34 Standardized CPUE ± confidence interval in the commercial fishery from 1994 to 2014 in Area 12C. The dotted line shows the data series average.

Fishery-independent survey. The trap-based research survey, conducted since, 2000 shows that the NUE of adults ≥ 95 mm decreased sharply in 2014, to a low value (Figure 35). The NUE of recruits (carapace conditions 1 and 2) increased to an above average value while adolescents ≥ 78 mm decreased to a value close to the average (Figure 36), suggesting a decrease in recruitment to the fishery in the medium term.

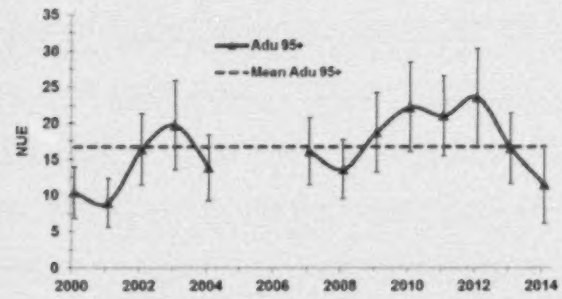


Figure 35. Catch rates (NUE), with confidence interval and average, of adult crabs ≥ 95 mm and those left by the fishery, from the post-season survey in Area 12C from 2000 to 2014 (except for 2005 and 2006).

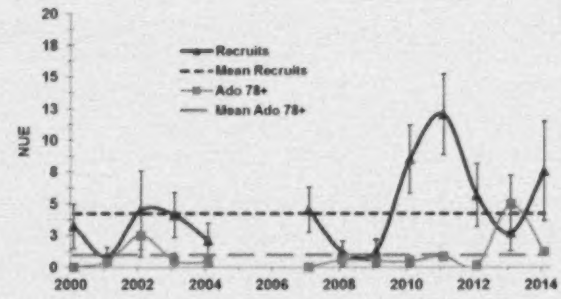


Figure 36. Catch rates (NUE), with confidence interval and average, of adolescent crabs ≥ 78 mm and recruits from the post-season survey in Area 12C from 2000 to 2014 (except for 2005 and 2006).

The combined index of commercial CPUE and of NUE from the post-season survey decreased in 2014. This index suggests that there will be less biomass available to the fishery in 2015 than there was in 2014.

Perspectives and conclusions

The drop in the combined index suggests that 2015 catches should decrease compared to 2014:

1. A status quo in catches would lead to a high harvesting intensity and possibly to a decrease in the biomass available to the fishery in 2016;
2. It is unlikely that an decrease of approximately 10% would lead to an excessively high harvesting intensity and would moderate the effect of lower expected recruitment in the medium term;
3. Any decrease greater than 15% could lead to the maintenance of a substantial biomass available to the fishery over a longer period of time.

Area 16A

Description of the fishery

Area 16A includes two banks (north and south sectors) separated by the deep channel of the Jacques-Cartier Strait. Since 2002, it has been accessible to the 43 Quebec fishers holding a Snow Crab fishing licence in Area 13. The TAC increased by 10% in 2013 and in 2014, to reach a peak of 515 t (Figure 37). The TAC was reached. The fishery opened on April 16 and closed on July 22.

Resource status in 2014

Commercial fishery. The standardized CPUE increased in 2014 compared to 2013 and is now sharply above the historical average (Figure 38). The recruits (carapace conditions 1 and 2), which have been on the rise since 2011, decreased and the majority of crab landings in 2014 consisted of intermediate-shell crabs (condition 3).

Fishery-independent survey. The trap-based research survey, conducted since 2002, shows that the NUE of adults ≥ 95 mm remained stable between 2013 and 2014, at a value near the historical average (Figure 39). The NUE of recruits and adolescents ≥ 78 mm increased in 2014 and are above average (Figure 40).

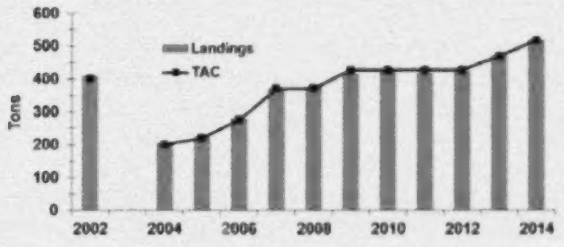


Figure 37. Landings and TAC in Area 16A from 2002 to 2014.

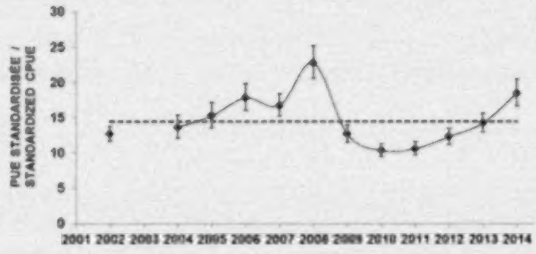


Figure 38. Standardized CPUE ± confidence interval in the commercial fishery from 2002 to 2014 in Area 16A. The dotted line shows the data series average.

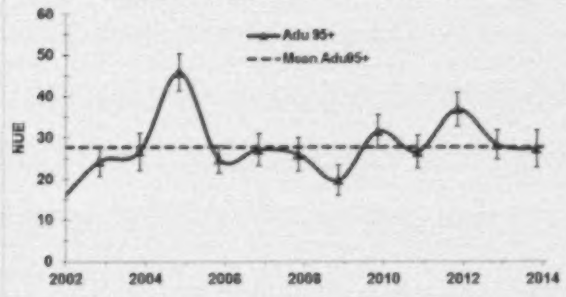


Figure 39. Catch rates (NUE), with confidence interval and average, of adult crabs ≥ 95 mm from the post-season survey in Area 16A from 2002 to 2014.

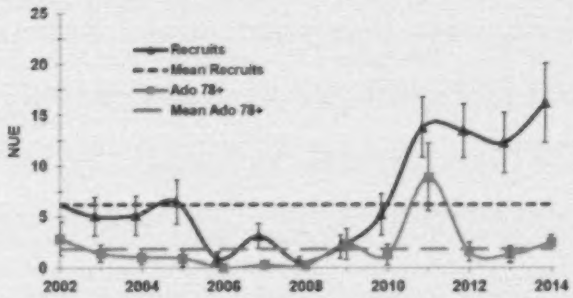


Figure 40. Catch rates (NUE), with confidence interval and average, of adolescent crabs ≥ 78 mm and recruits from the post-season survey in Area 16A from 2002 to 2014.

The combined index of commercial CPUE and of NUE from the post-season survey increased in 2014 and is now above average. This index suggests that the biomass available to the fishery in 2015 could be greater than in 2014.

Perspectives and conclusions

The rise in the combined index suggests that it is possible to slightly increase 2015 catches compared with 2014:

1. An increase in catches greater than 15% would lead to a high harvesting intensity and could decrease the biomass available to the fishery in 2016;
2. It is unlikely that an increase of approximately 10% would lead to an excessively high harvesting intensity and could foster maintenance of the biomass available to the fishery;
3. A status quo or decrease in catches could lead to the maintenance of a substantial biomass available to the fishery over a longer period of time.

Sources of uncertainty

The quality of science advice depends mainly on the accuracy of parameters obtained through sampling and the subsequent analyses. Information obtained from logbooks and purchase slips during the fishing season affects the accuracy of the parameters derived from these documents. For instance, abundance indices and fishing effort calculations obtained from logbooks may include errors that will affect the science advice provided. The selectivity and catchability of traps can vary depending on the type of trap used, its volume and the size of the mesh covering the trap, the amount and quality of bait used and soak time, which can vary with the fishing strategies employed and prevailing environmental conditions. The catchability of adolescent crabs and recruits can also be affected by the abundance of intermediate-size crabs (condition 3) on the seafloor. The selective sorting of catches can also affect the quality of the data obtained.

The abundance and condition indices and the estimates of crab size obtained from the trawl and trap surveys depend on the type of gear used and are affected by uncertainties related to catchability variations in the different crab groups targeted. Some types of fishing gear are better suited to given seafloor areas than other types and this factor influences the spatial coverage ultimately sampled. The biological characteristics specific to Snow Crabs can also create sources of uncertainty that impinge on

the science advice. For instance, the terminal moulting phase, which occurs at various sizes, will affect crab condition and catchability. Natural mortality can also vary with the life stage and condition of the crabs.

SOURCES OF INFORMATION

This Science Advisory Report is from the February 24 and 25, 2015 meeting on the Assessment of the Estuary and northern Gulf of St. Lawrence Snow Crab stocks. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada Science Advisory Schedule as they become available.

Dufour, R. and J.-P. Dallaire. 2003. Status of snow crab populations in the St. Lawrence Estuary and the Northern Gulf of St. Lawrence from 1999 to 2001. DFO Can. Sci. Advis. Sec. Res. Doc. 2003/048. [Available in French only]

DFO 2014 Assessment of the Estuary and Northern Gulf of St. Lawrence (Ares 13 to 17, 12A, 12B, 12C and 16A) Snow Crab Stocks in 2014. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2014/035.

Sainte-Marie, B., J.-M. Sévigny and M. Carpentier. 2002. Interannual variability of sperm reserves and fecundity of primiparous females of the snow crab (*Chionoecetes opilio*) in relation to sex ratio. Can. J. Fish. Aquat. Sci. 59: 1932-1940.

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